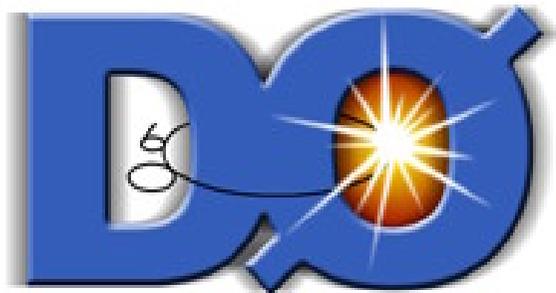


$D\emptyset$ Results on New Phenomena (BSM) Searches

Subhendu Chakrabarti

DAPNIA CEA Saclay

On behalf of $D\emptyset$ collaboration

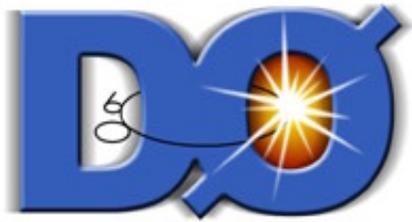


**Lake Louise Winter Institute
18 -24 Feb. 2007**

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Outline

Various model dependent searches exist for New Physics (Beyond Standard Model) at DØ

Only overview of a subset of most recent results are presented here, More results in, <http://www-d0.fnal.gov/Run2Physics/WWW/results/np.html>

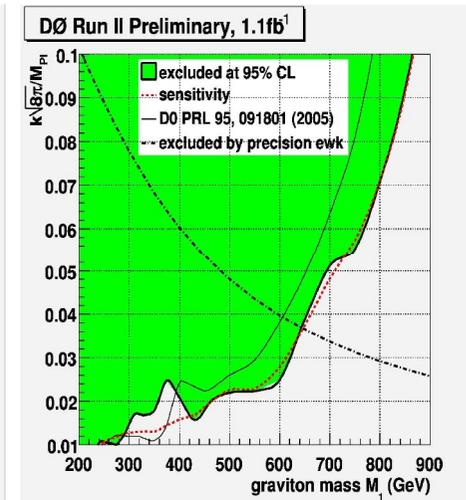
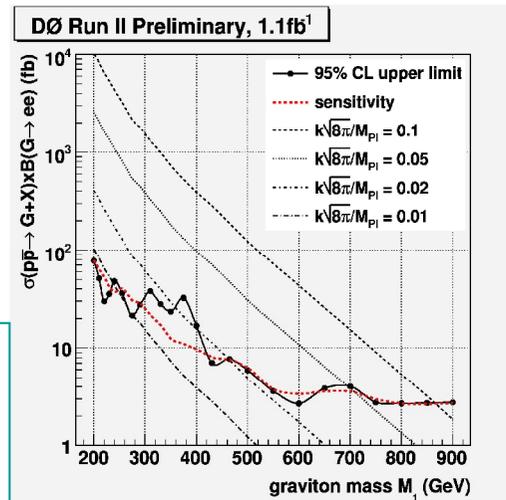
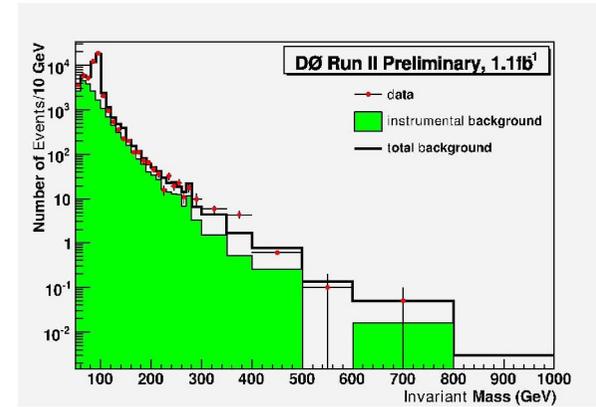
- ❖ Extra dimensional Randall-Sundrum Graviton
- ❖ New Heavy Charged Boson W'
- ❖ SUSY Trileptons
- ❖ Squarks and Gluinos
- ❖ GMSB SUSY in $\gamma\gamma$



Search for Randall-Sundrum Graviton

$$G \rightarrow e^+ e^- / G \rightarrow \gamma\gamma$$

- Search for two EM clusters, with $P_T > 25$ GeV and $|\eta| < 1.1$
- Data matches with SM Zee production and QCD background, **No excess!**
- **Exclusion at 95% CL**
First RS excited resonance Graviton mass and dimensionless coupling constant



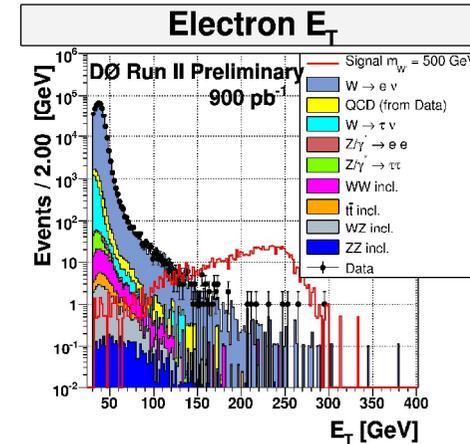
$$M_1 < 865 \text{ GeV for } k\sqrt{8\pi}/M_{pl} = 0.1$$

$$M_1 < 240 \text{ GeV for } k\sqrt{8\pi}/M_{pl} = 0.01$$

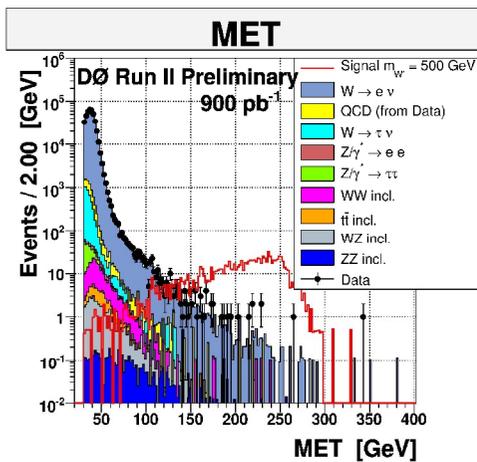
Search for New Heavy Charged Boson W'

- **Event Selection** $W' \rightarrow e \nu$
- Electrons with $E_T > 30$ GeV and $|\eta| < 1.1$
- Ratio of $E_{T,e}/MET$ within (0.7-1.3)
- If Jet $P_T > 15$ GeV in event, $\Delta\phi(j, MET/e) < 2.5$
- $MET > 30$ GeV
- $M_T > 150$ GeV

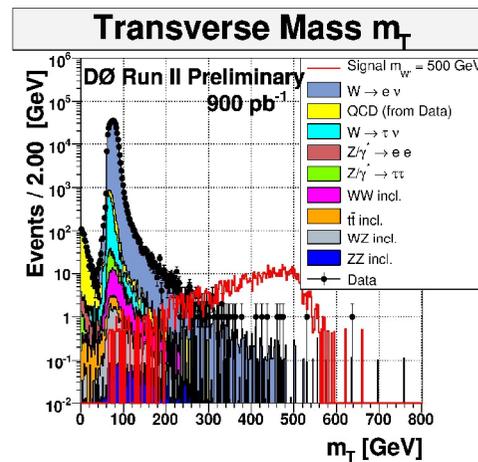
data matches with SM background prediction



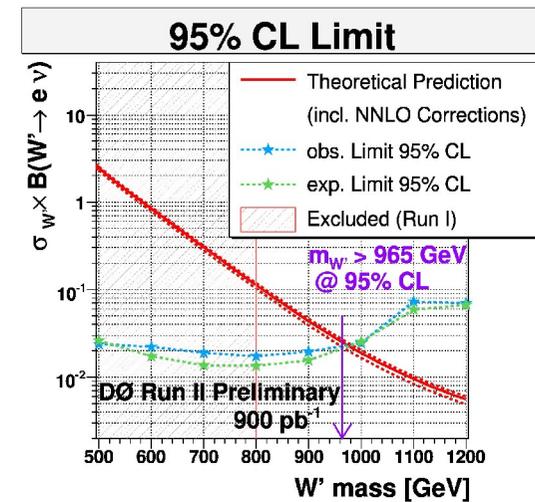
- $m_{W'} > 965$ GeV @ 95% CL



Subhendu Chakrabarti



D0 Results on New Phenomena (BSM) Searches

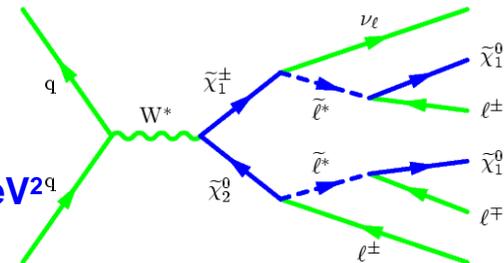


Search for SUSY Trileptons

Associated Chargino/Neutralino Production

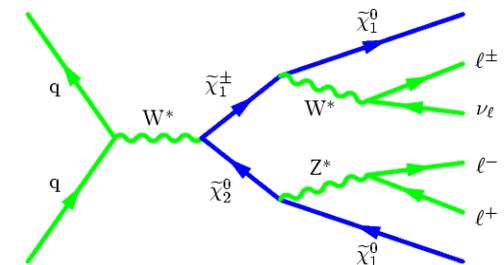
Cleanest channel in hadron colliders for SUSY search

- **Upgraded analysis eel**
- Require two electrons $P_T > 8/12$ GeV/c, third lepton $P_T > 4$ GeV/c
- $\Delta F(e,e) < 2.9$, Z mass veto (18-60) GeV
- $MET > 22$ GeV, $M_T > 20$ GeV, MET significance > 8 , MET. $P_{T13} > 220$ GeV^{2q}
- $H_T < 80$ GeV (Anti top cut)



NO candidates found $L=1.1$ fb⁻¹
Expected background 0.76 ± 0.67

- **Upgraded analysis likesign $\mu\mu$**
- Require two likesign isolated muons $P_T > 13/8 (< 35)$ GeV/c
- Invariant mass cut $M_{\mu^\pm\mu^\mp}$ (25-65), $M_{\mu^\pm\mu^\pm}$ (12-110) GeV/c²
- M_T (15-65) GeV/c², MET > 10 GeV, MET significance > 12 GeV, MET .PT $\mu_2 > 160$ GeV^{2/c}



Observed one event $L=0.9$ fb⁻¹
Expected background 1.1 ± 0.4

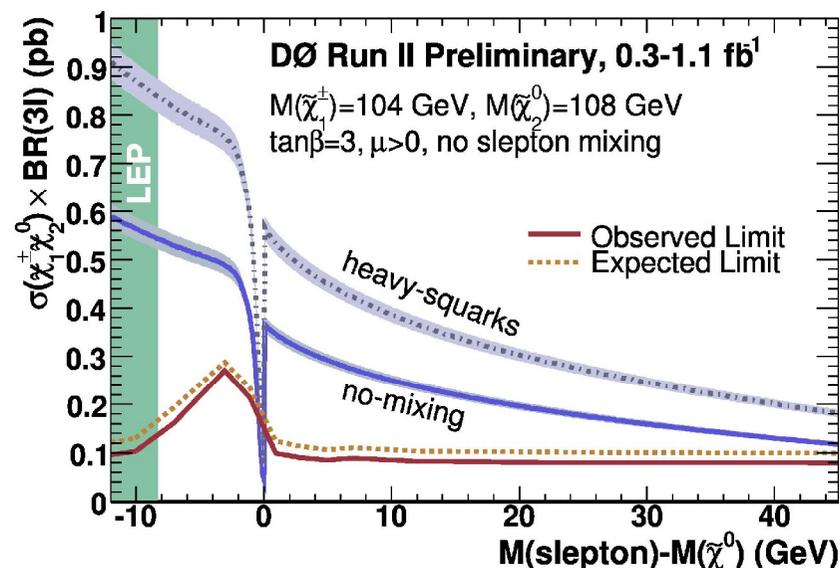
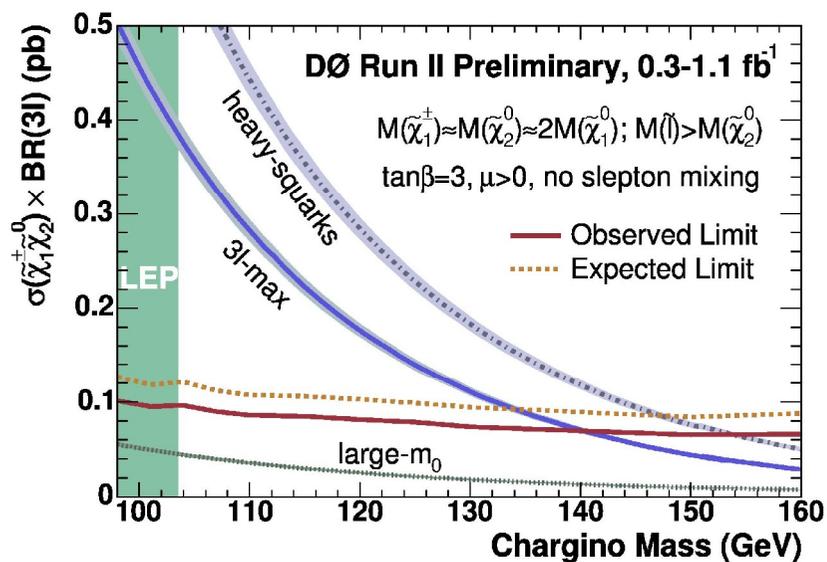
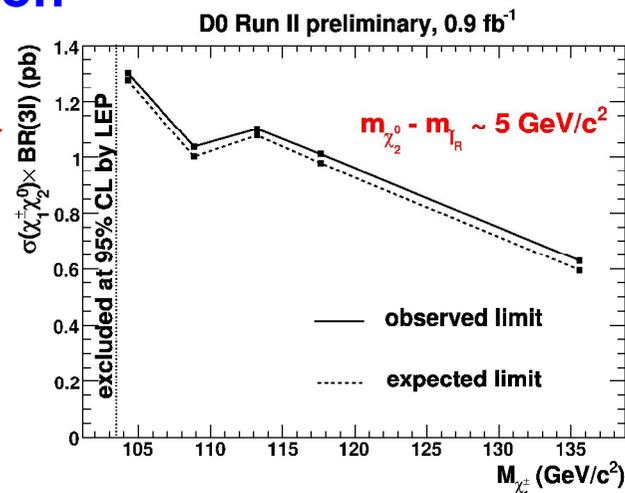
NO EVIDENCE for SUSY

Search for SUSY Trileptons

Associated Chargino/Neutralino Production

- **Limits on $\sigma \cdot BR$ for five MSugra points** \rightarrow
- **Chargino mass region below 140 GeV/c² ruled out (LEP 103 GeV/c²)**

Combined results with $e\mu, \mu\mu, ee$, like sign $\mu\mu$



Search for Squarks and Gluinos in jets + MET

Three different parameter region with $\tan \beta=3$, $A_0=0$, $\mu < 0$

Low $m_0 \rightarrow$ dijet (GeV)

$$m_{\text{squark}} 375 < m_{\text{gluino}} 416$$

$$m_0=25, m_{1/2}=165$$

Intermediate region 3jets

$$m_{\text{squark}} 380 m_{\text{gluino}} 380$$

$$m_0=188, m_{1/2}=145$$

high $m_0 \rightarrow$ gluino (GeV)

$$m_{\text{squark}} 542 > m_{\text{gluino}} 296$$

$$m_0=500, m_{1/2}=100$$

Event Selection

- Acoplanar dijet
 $p_T > 35 \text{ GeV } |\eta| < 2.5$
- e/μ veto
- $\Delta\phi(\text{MET}, j_1/j_2) > 90^\circ/50^\circ$
- $\text{MET} > 225 \text{ GeV}$
- $\text{HT} > 300 \text{ GeV}$

- dijet search corresponds to scenario when squarks are much lighter than gluinos, so mostly squarks produced multijet is when gluino is much lighter than squarks

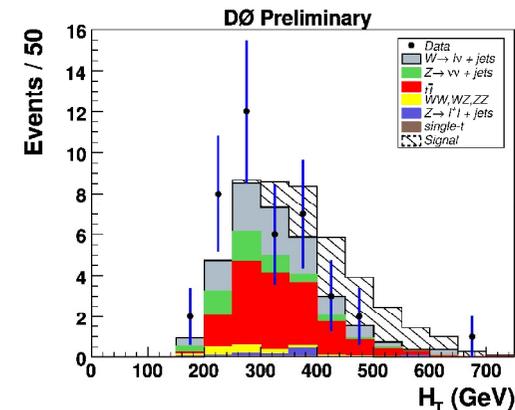
Multijet with 3 jets

- $p_T > 35 \text{ GeV } |\eta| < 2.5$
- e/μ veto
- $\Delta\phi(\text{MET}, j_1/j_2) > 90^\circ/50^\circ$
- $\text{MET} > 150 \text{ GeV}$
- $\text{HT} > 400 \text{ GeV}$

Multijet with 4 jets

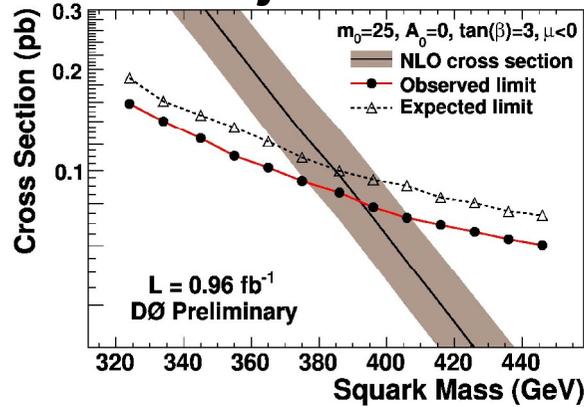
- $p_T > 35/20 \text{ GeV } |\eta| < 2.5$
- e/μ veto
- $\Delta\phi(\text{MET}, j_1/j_2) > 90^\circ/50^\circ$
- $\text{MET} > 100 \text{ GeV}$
- $\text{HT} > 300 \text{ GeV}$

Good agreement with SM prediction

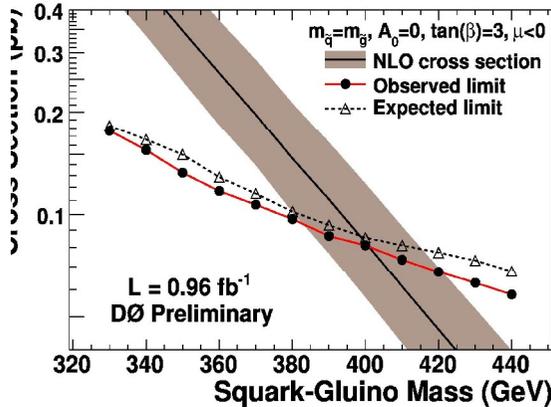


Search for Squarks and Gluinos in jets + MET

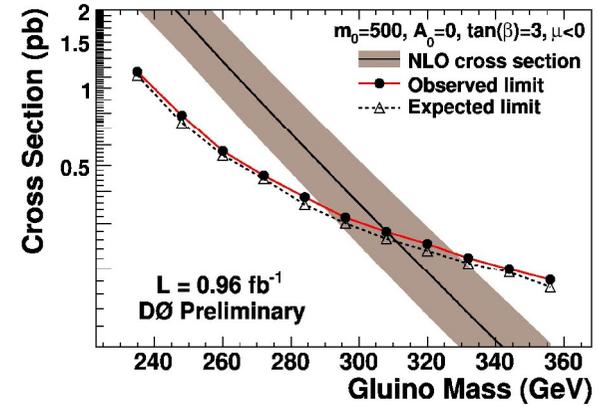
dijet



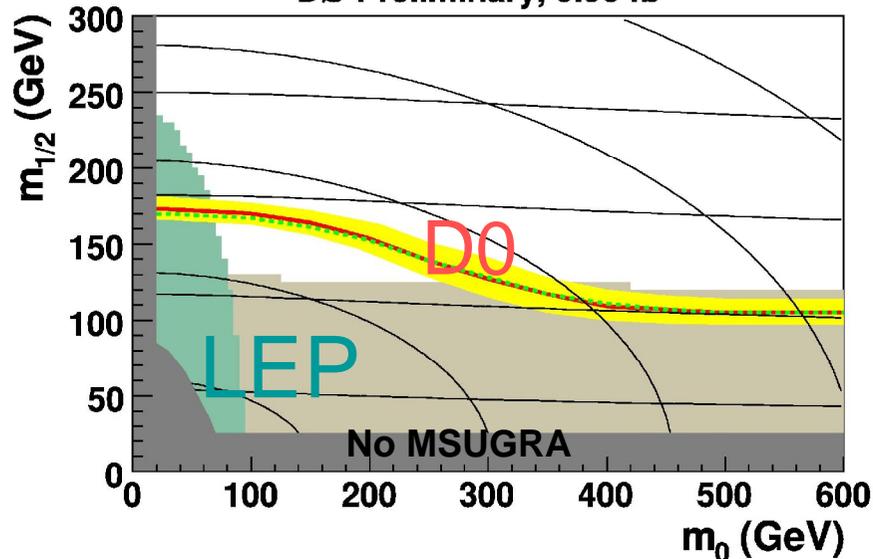
intermediate



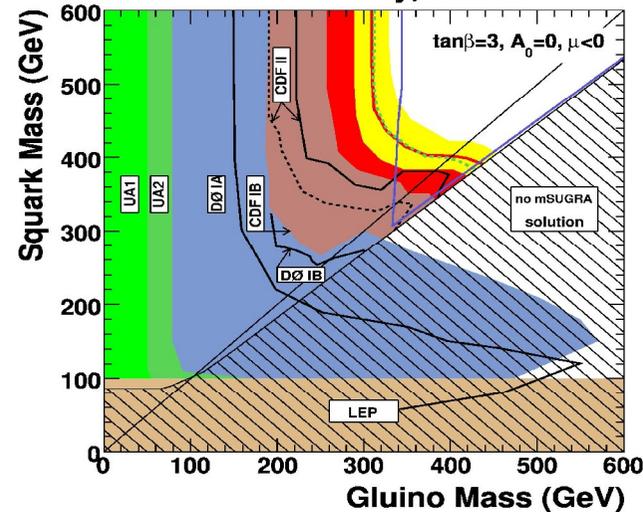
gluino



DØ Preliminary, 0.96 fb^{-1}



DØ Preliminary, 0.96 fb^{-1}



GMSB Inspired SUSY Models in $\gamma\gamma$

- Search for Gauge mediated SUSY breaking with NLSP**

Require: 2 photons $E_T(\gamma) > 25$ GeV

MET > 45 GeV

No back-to-back jet with MET

$\Delta F(\text{MET}, \text{jet}) < 2.5$

Remaining 4 candidate events in data

Total expected background 2.1 ± 0.7

Messenger mass $M_m = 2\Lambda$

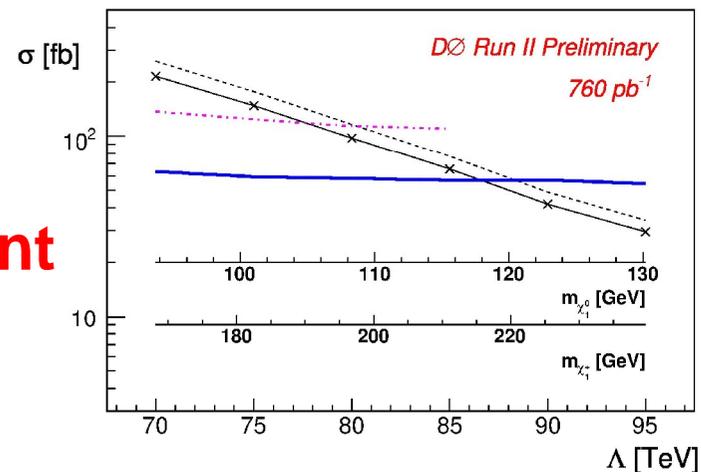
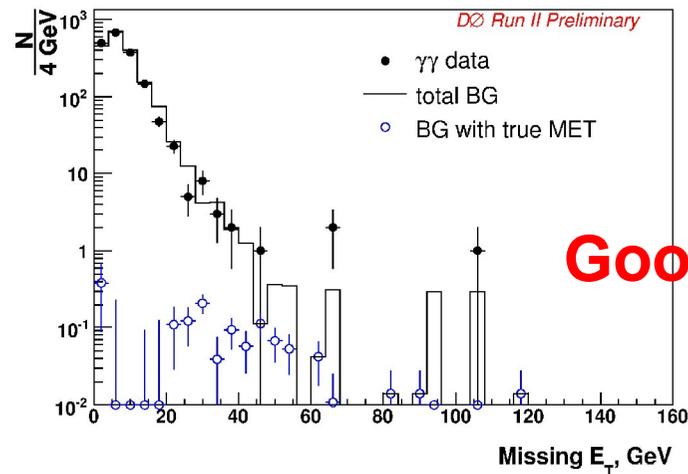
No of messengers $N_5 = 1$

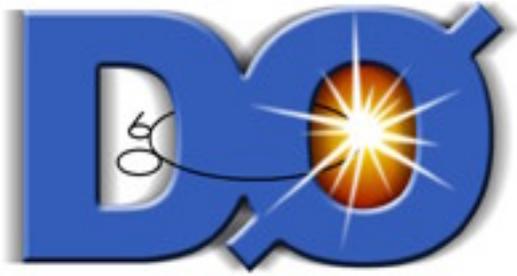
$\tan \beta = 15$ $\mu > 0$

Lower limit on lightest

Neutralino Mass > 120 GeV

Chargino Mass > 220 GeV





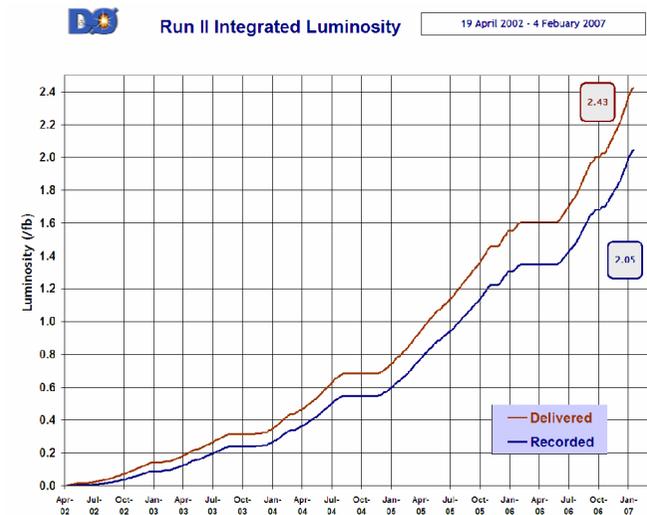
Conclusions

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- ❑ No evidence of New Phenomena with 1 fb^{-1} data yet !
- ❑ Several New Phenomena Search reaching sensitivity in the parameter space well beyond existing limits
- ❑ More data on tape
Stay tuned.



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